Quiet-Sun Planetary Magnetospheres

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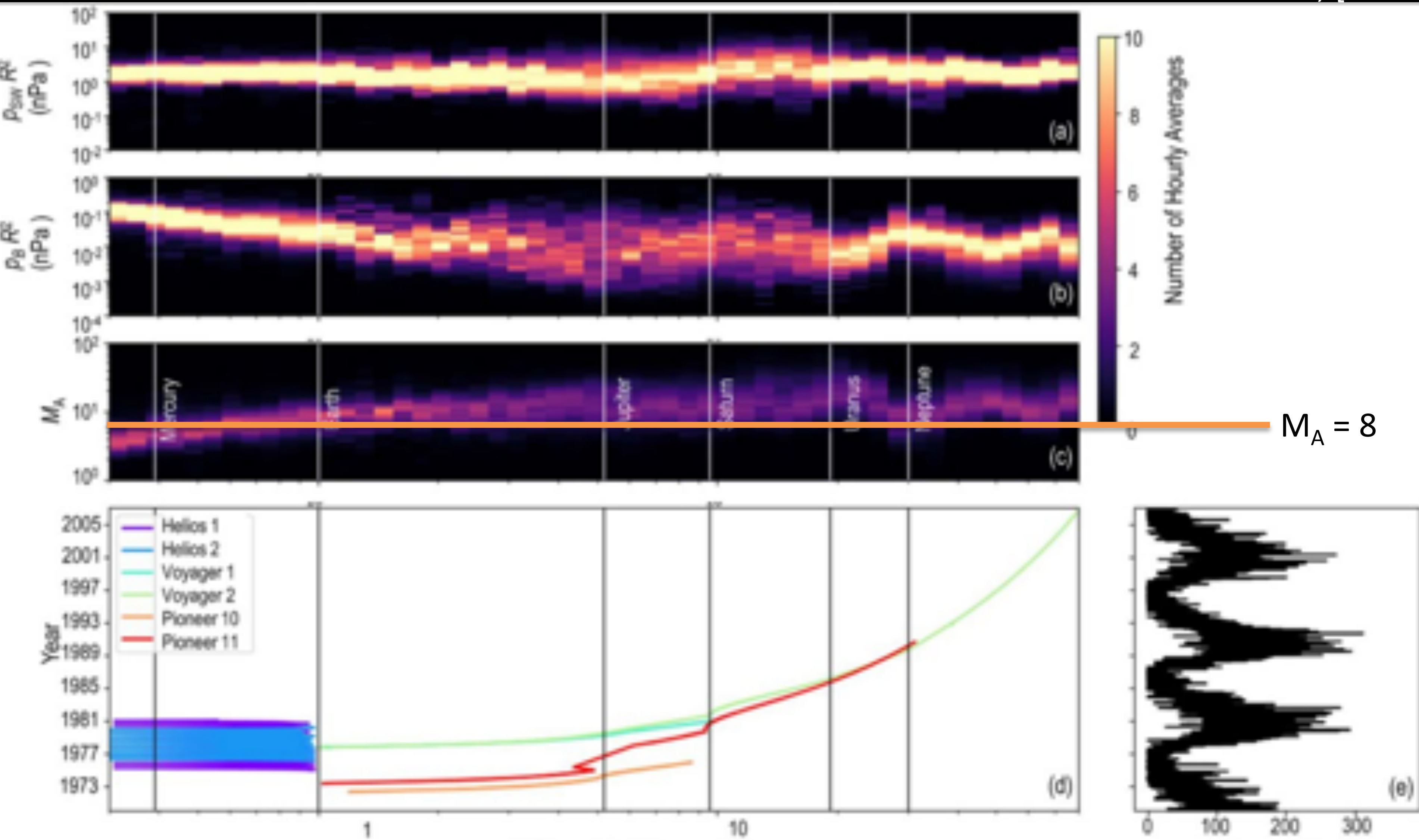
WHPI Workshop
17 September 2021

Solar wind forcing throughout the heliosphere

Gershman and DiBraccio, [2020]



Lower M_A (i.e., < ~8) tends to result in increased magnetopause reconnection

Mercury

The upstream M_A at Mercury is nearly always <8, even during solar minimum, and Mercury has no significant internal plasma source

External forcing dominates at Mercury

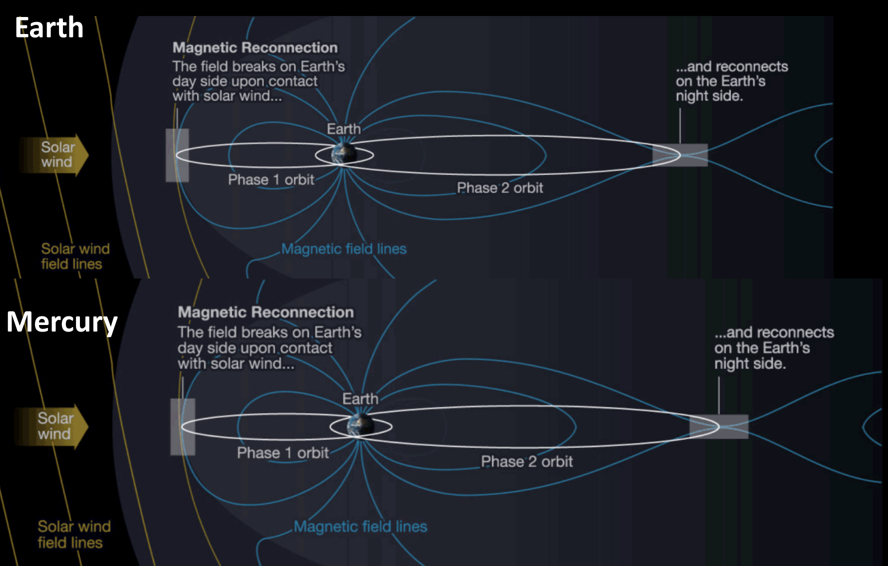
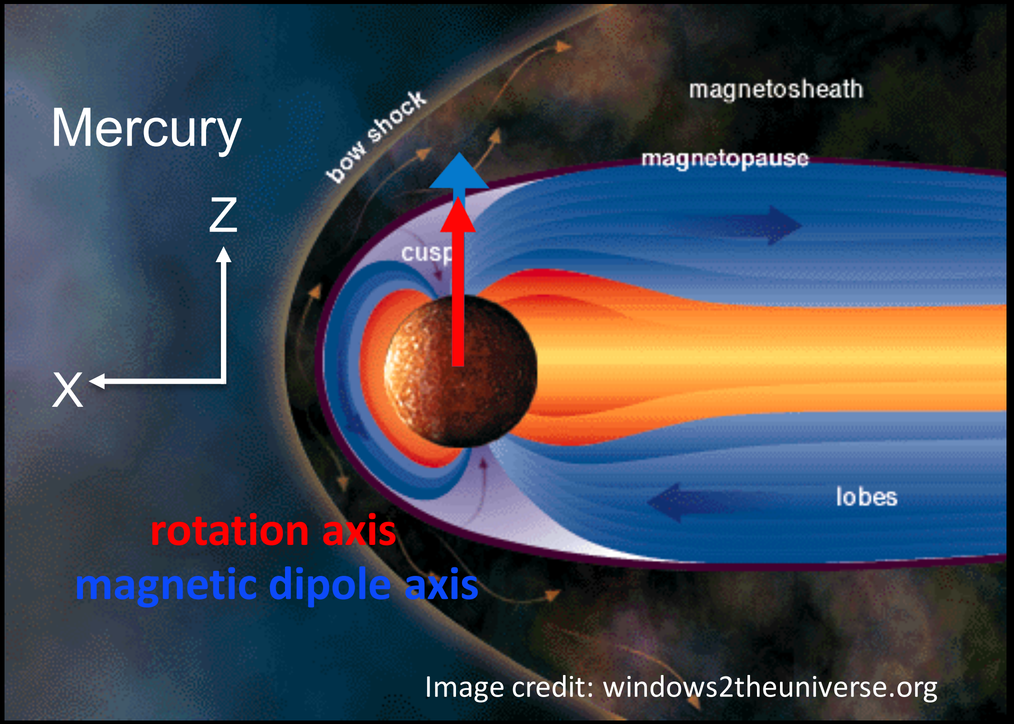


Image credit: National Geographic



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Gas Giant Magnetospheres (Jupiter, Saturn)

At solar minimum, the upstream M_A at Jupiter and Saturn is rarely below 8 and but these magnetospheres are dominated by plasma from satellites (Io and Enceladus)

Internal forcing dominates at Jupiter and Saturn

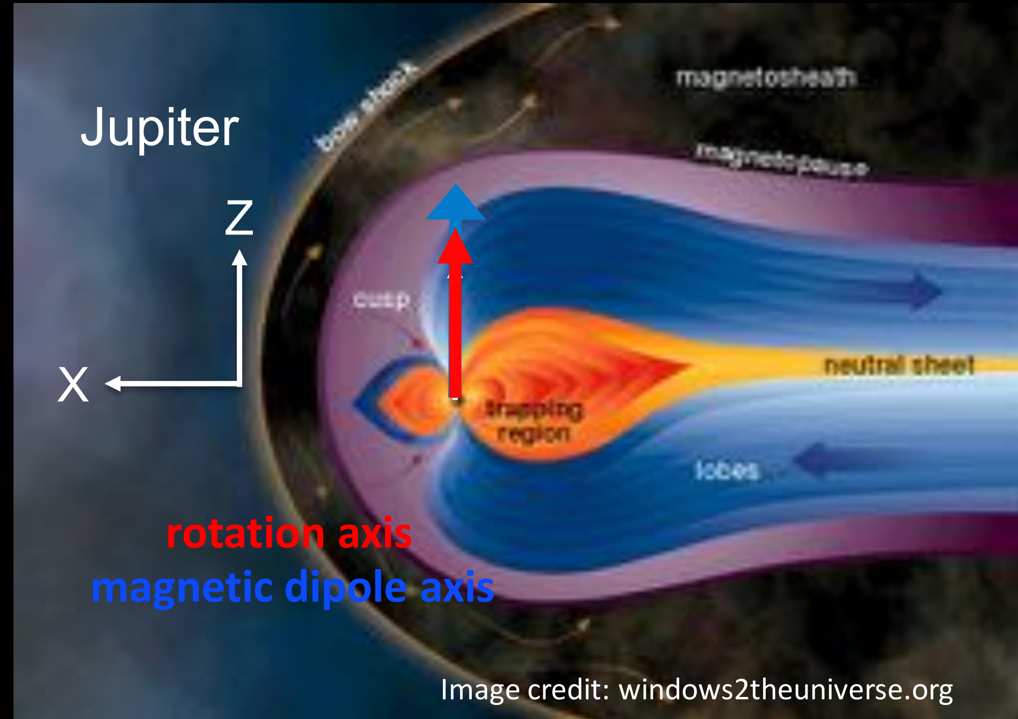

Image credit: windows2theuniverse.org


Image credit: BBC Earth Unplugged

Ice Giant Magnetospheres (Uranus, Neptune)

Mix of planetary and solar wind plasma but no strong satellite sources

Highly tilted rotation and magnetic dipole axes can lead to increased magnetic shear angles with IMF [Gershman and DiBraccio, 2020] and solar wind-driven convection can penetrate into the inner magnetosphere [Vasyliunas, 1986]

M_A is > 8 during solar minimum, but more viscous (Kelvin-Helmholtz) interactions may become important [Masters, 2018]

External forcing (maybe?) dominates at Uranus and Neptune

Large diurnal (17 hours) and seasonal (84 years) variations in geometry

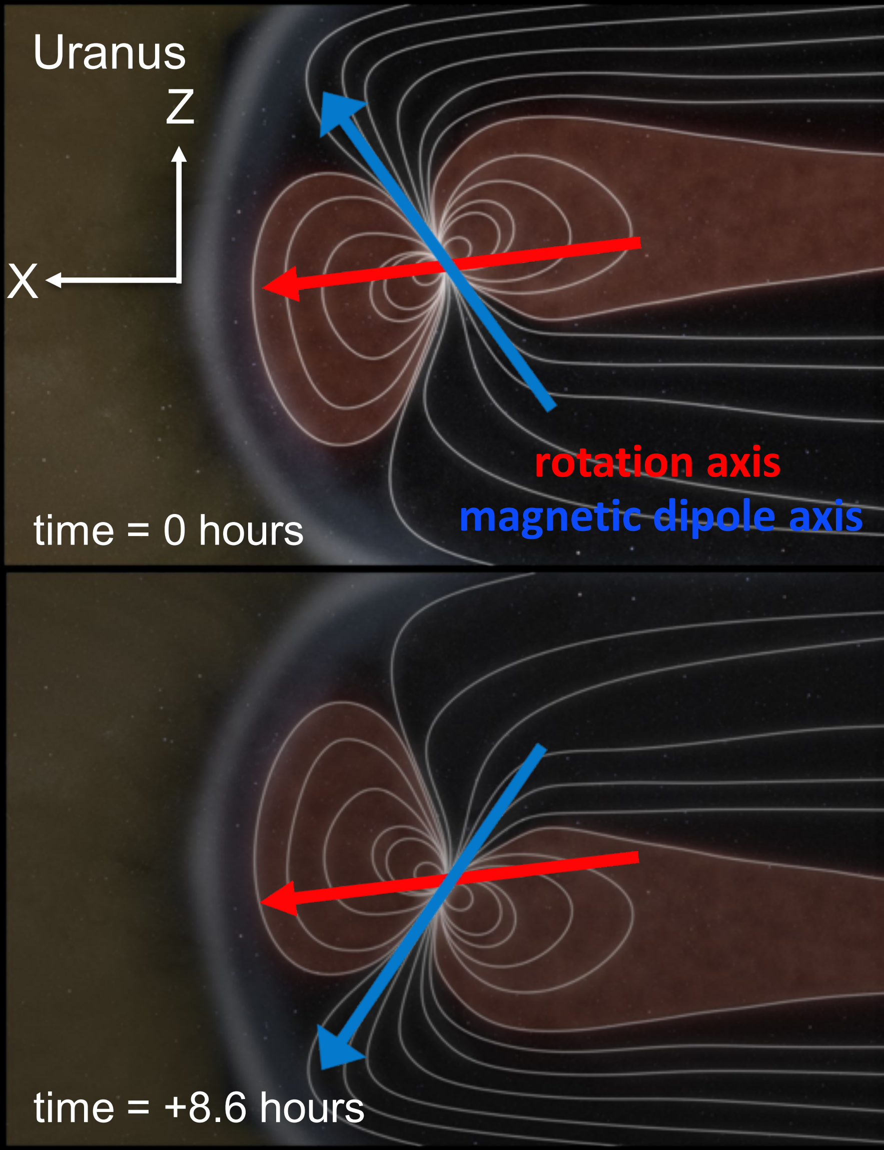

Image credit: Walt Feimer

Concluding Remarks

- At solar minimum, the upstream M_A at all planetary magnetospheres is higher, reducing the overall rates of magnetopause reconnection
- The transport of plasmas throughout most planetary magnetospheres are still largely driven by the solar wind, even under quiet sun conditions.
- Jupiter and Saturn’s magnetospheres are the mostly weakly driven by the solar wind
- The nature of Uranus and Neptune’s magnetospheres still require a lot of study (and a lot of new data!)